

**December 2005 final report for Grant No. NAC/ISDA 2005-1**

**A. Title of Project:** Development of improved landscape plants

**B. Name of Principal Investigator:** Harold Pellett, Ph.D.

**C. Name of Institution:** Landscape Plant Development Center

**D. Date submitted:** December 20, 2005

**E. Time Covered by report:** Calendar year 2005

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### **Summary of progress**

The Center's research effort to develop durable landscape plants is an ongoing effort. We work with many different plant species and our goal is to develop superior new cultivars for all geographic regions. We made our first 3 plant introductions (*Pyrus* Silver Ball™, *Physocarpus* 'Center Glow'<sup>PPAF</sup> and *Clematis* 'Center Star'<sup>PPAF</sup>) in 2005 and have many exciting selections of *Pyrus*, *Buddleia*, *Weigela*, etc. under evaluation. First generation hybrids resulting from interspecific crosses are growing and several populations are now beginning to flower which will enable us to grow second generation hybrids in various climates to select superior plants well adapted to the different geographic regions. Populations of *Acer* (Japanese maples) and *Carpinus* are in this group. We continue to expand our activities with additional plant species as funding allows. Since the interim report, we have budded selections of *Pyrus* and propagated many additional selections of *Buddleia*, *Weigela*, *Cornus*, etc. for further evaluation. We have also collected seed from crosses made in spring of 2005. Seed of hybrids between *Acer palmatum*, *A. pseudosieboldianum* and *A. japonicum* have been planted in seedbeds in Minnesota for selection of cold hardy individual plants. Status of projects underway and activity in 2005 is included in the following information:

### **Ornamental Pears:**

#### **Overall status of project:**

Cooperators at the following institutions are continuing to evaluate segregating populations of our second-generation pear hybrids for selection of promising individual plants that are well adapted to their respective regional conditions. (University of Georgia – Griffin; Cornell University, Penn State University, Texas A & M, Bernheim Arboretum, North Carolina State University – Mt. Horticultural Research Station, Iowa State University, Michigan State University, University of Minnesota, University of Arizona, and at the Center's research station in Oregon) These were planted in 2001. Additional crops of F2 seedlings were grown in 2001, and 2002, and screened for resistance to fireblight. Survivors from the 2001 crop were field planted at the Oregon station in 2002. Survivors from the 2002 crop were planted in Oregon and Kansas. Additional controlled crosses are being made each year and screened for fireblight resistance before planting out for selection. Selections propagated asexually were planted in 2003 for evaluation in Georgia, Pennsylvania, North Carolina, New York, Michigan, Minnesota, Iowa, Texas, Kansas, Oklahoma, Idaho, California, and Washington.

#### **Activities during the past year:**

1. Additional crosses were made in spring of 2005 between selected first generation hybrids growing at WSU-Puyallup. Unfavorable cool weather hindered the flowering and a late frost killed many of the flower buds greatly reducing the amount of breeding accomplished.
2. Additional selections were made and propagated by budding in late summer of 2005.
3. Reduced flowering and fruit set in spring of 2005 has made it difficult to get good data on fruit size and fertility. We are continuing to evaluate quality of the plants that were identified as probably sterile in 2004 and those with small fruit.
4. The cool wet spring in 2005 produced ideal conditions for rust disease resulting in heavy infestation of most of the pear plants. As a result we have identified a few plants that have excellent resistance to this disease.

5. We are getting good feed back from cooperators on performance of selections sent out previously for evaluation. A couple of selections have been made in Arizona of plants that are resistant to high soil pH. These were propagated in late August 2005 to produce plants for further evaluation.
6. Some of the dwarf selections may have potential for use as dwarfing rootstocks for fruiting pear varieties. We initiated efforts to explore this potential by budding dwarf selections onto seedling rootstocks. DeAnjou pear was budded onto these in August 2005 leaving a 10-12 inch interstem of the dwarf varieties. Those that show dwarfing characteristics will then be propagated on their own roots to test as dwarfing rootstocks.
7. A compact selection with silver foliage has been selected for introduction and is being produced by J. Frank Schmidt & Son Co. It has been named Silver Ball™ (photo on right)



#### ***Acer* and *Carpinus* Breeding:**

##### **Overall status of project:**

The *Acer* and *Carpinus* breeding projects are a cooperative effort between the Center and the Morton Arboretum. Dr. Susan Wiegrefe made the initial crosses working as a postdoctoral fellow for the Center. She utilized plants growing in the collections of the Morris Arboretum, Arnold Arboretum, Holden Arboretum and the Morton Arboretum as parents. When Dr. Wiegrefe accepted a plant breeding position at the Morton Arboretum, The Center and the Morton Arboretum entered into an agreement to continue the effort as a cooperative project between the two institutions. Currently F1 populations of these genera are growing at the Morton Arboretum and at the Center's research station in Oregon.

##### **Activities during the past year:**

1. Many of the F1 hybrids between the species *A. palmatum*, *A. pseudosieboldianum*, and *A. japonicum* growing at the Center's Oregon research station are now flowering. Crosses made in 2004 between selected F1 hybrids are being grown at the Morton Arboretum. Open pollinated seed collected in fall of 2005 will be grown in Minnesota to select for hardy individual plants in the second-generation progeny.



Fall color on an *Acer pseudosieboldianum* X *Acer japonicum* hybrid.



2. Some of the F1 hybrids of *Carpinus* have very nice plant form and excellent foliage qualities. These are being selected and propagated for further evaluation. A few of the F1 hybrids between *C. caroliniana* and *C. betulus* are now flowering and seed will be collected this fall for growing of the F2 population.



*Carpinus* hybrids exhibit a broad range of plant forms.

### ***Clematis* Breeding:**

**Overall status of project:** We have made good progress in developing non-vining cultivars of *Clematis*. Hybrids between *Clematis integrifolia* and *C. hexapetala* are very promising. Flowers are blue in color and upright facing. We also have many hybrids between *C. integrifolia* and *C. recta*. These have smaller flowers and are also upfacing. In addition we have a few hybrids between *C. integrifolia* and some of the large flowered vine cultivars. A few of these have flowered and are quite interesting.

### **Activities during the past year:**

1. Plants resulting from crosses made in 2003 between *C. integrifolia* and large flowered, vine cultivars and between *C. integrifolia rosea* and *C. hexapetala* are now being grown.
2. Plants from 2002 crosses are now growing in a field planting at the Oregon research station.
3. Donahue's Greenhouse, a nursery that specializes in production of *Clematis* has been licensed to grow our selection of *C. integrifolia* x *C. hexapetala*. The plant has been



A promising large flowered selection that is being propagated for broader testing.

named ‘Center Star’ and application has been made for a plant patent. It combines the blue flower color from the female parent and the upfacing flowers of the male parent. Flowers are 1½ to 2" in diameter. Foliage is a dark glossy green.

4. Hybrids, resulting from crosses between *C. integrifolia rosea* with *C. hexapetala* and with large flowered vining cultivars in an attempt to extend the flower color range, are now growing at the Oregon research station.

### Improvement of Native Plants:

#### Overall status of project:

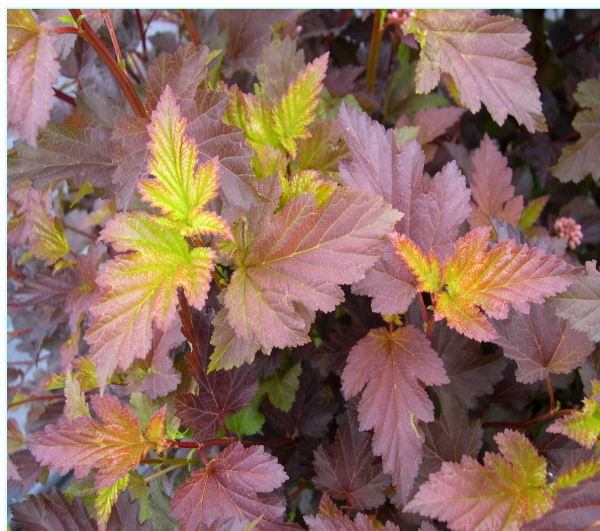
In cooperation with Dr. Robert Schutzki, Michigan State University, Dr. Mark Widrlechner, North Central Regional Plant Introduction Station, we collected native woody plants in the states of Iowa, Michigan and Minnesota in fall of 2003 and 2004. These are being grown to select superior individual plants and to utilize in breeding. We also have made some crosses and have plants of a few species that were treated with Ethyl Methane Sulfonate, a chemical mutagen that are being evaluated.

#### Activities during the past year:

1. The one resulting plant from crosses made in 2003 between *Cornus sericea* ‘Cardinal’ and *C. s.* ‘Isanti’ to develop a compact variety with brighter winter twig color looks quite promising as it continues to readily break bud at nodes throughout the growing season. Plants from open pollinated seedlings of *C. sericea* ‘Cardinal’ that were treated with Ethyl Methane Sulfonate, a chemical mutagen, also look quite promising. These plants
2. Hybrids between *Physocarpus opulifolius* Diabolo™ and *P. o.* ‘Dart’s Gold’ have brighter leaf color than Diabolo™. Nurseries have been licensed and are now growing one selection that has been named ‘Center Glow’. A plant patent application has been submitted. Royalties resulting from our plant patents will be used to help us continue and expand our breeding efforts.



*Ceanothus americanus* is a native small shrub that was collected and is being evaluated



‘Center Glow’ Ninebark



### Development of Sterile Cultivars by Ploidy Manipulation:

#### Overall status of project:

We are working to develop sterile cultivars by modifying ploidy levels. We are treating plants with oryzalin to produce tetraploids. These will then be crossed with diploid plants to produce triploids, which are most frequently sterile. We are cooperating with Dr. Tom Ranney, North Carolina State University, Mountain Horticultural Research Center in that effort.

#### Activities during the past year:

1. Tetraploids of crabapple, *Acer platanoides* and *Acer ginnala* have been verified by flow cytometry from plants treated with oryzalin.
2. *Acer ginnala* tetraploids produced seed in 2004 and open pollinated seedlings are now growing. These will be tested by flow cytometry to determine ploidy level. Controlled crosses were made in spring of 2005 between the tetraploid plants and normal diploid plants.
3. We continue to observe hybrids resulting from wide crosses to identify sterile plants. Several of our selected pear hybrids appear to be sterile. Some selections of *Buddleia* appear to have poor fertility and one selection appears to be completely sterile. Pollen of selected pear hybrids was sent to Dr. Ranney who used it in crosses with tetraploid *Pyrus calleryana* that he has induced.

### Cooperative Breeding Program with Cornell:

#### Overall status of project:

To expand our overall efforts in breeding landscape plants, we initiated a cooperative breeding program with Cornell University in 2003 and contracted with Peter Podaras to make crosses utilizing plants growing at the Cornell Plantations. Office, greenhouse and field facilities of the Horticulture Department are available to facilitate this cooperative research effort.

#### Activities during the past year:

1. Peter is continuing to make a lot of crosses in many different plant species in 2005. Heavy emphasis has been in crossing *Buddleia* and *Weigela* on advanced generations growing in the greenhouse and on *Quercus* in the field. Over 1700 *Quercus* cross combinations were made in the spring of 2005. We had good nut production from many interspecific crosses.



Peter Podaras with hybrid oak populations

2. Plants resulting from interspecific crosses of the following species made in 2003 and 2004 are now growing in the field: *Asclepias*, *Baptisia*, *Betula*, *Buddleia*, *Calycanthus*, *Cornus*, *Diervilla*, *Hypericum*, *Quercus*, *Platanus*, *Sambucus*, and *Weigela*
3. Breeding efforts with *Buddleia* are continuing and recent crosses will produce plants of the 5<sup>th</sup> generation. We have many interesting selections that we are propagating for further evaluation. These include plants with different plant forms, flower color, foliage



Rooted cuttings of 3 *Weigela* selections (above left), and



color, degrees of sterility and potential cold hardiness. Objectives in the *Buddleia* breeding effort are to develop hardier cultivars and dwarf cultivars. Sterile cultivars are also a goal. At present we have selected a number of promising plants with compact plant habit and have one completely sterile selection.

4. We also continue to explore potential for intergeneric hybridization between closely related genera. Based on the previous



Silver foliage selection of *Buddleia*.

success of hybridization of *Aronia* with *Chaenomeles*, Peter attempted crosses between *Sorbus*, *Amelanchier*, and *Pyrus* with *Chaenomeles* in spring of 2005. Fruit are developing from the crosses and hopefully will mature without abortion. Crosses between *Buddleia* and *Spigella* made in 2004 produced progeny that have flowers like *Buddleia* in appearance but much larger in size. Some of these progeny have different degrees of sterility. Progeny resulting from crosses between *Diervilla* x *Weigela* may have resulted from pollen contamination and are not true hybrids based on initial plant appearances. F2 plants also appear much like *Diervilla* but flowers on a few plants are slightly different than the rest. We are still unclear whether we have actual intergeneric hybrids.

### **Initiation of Cooperative Research Efforts with North Dakota State University**

We have entered into an agreement with Dr. Wenhao Dai at North Dakota State University to cooperate in an effort to utilize biotechnological approaches for landscape plant improvement. North Dakota State University has excellent facilities for tissue culture and related research activities and the Center is providing funding for a research technician, Cielo Castillo who was recently hired to work on the project. The research that is planned to develop new landscape plants includes different approaches. These are: 1. Genetic transformation to introduce genes that result in dwarf plants, sterile plants, color changes in flowers, or foliage, and possibly resistance to different diseases depending on the plant species; 2. Ploidy manipulation to produce sterile cultivars; and 3. Mutation breeding techniques to induce sterility, dwarfness or color changes.

#### **Initial Activities:**

Cielo Castillo is establishing tissue cultures of many different species in which dwarf or sterile cultivars would be desirable. Dr. Pellett and Dr. Dai have established and are expanding this list. After *in vitro* cultures of the various plants are well established, experiments to develop protocol for initiation of adventitious shoots will then be carried out. Transformation and mutation breeding procedures will then be undertaken with plants that reliably produce adventitious shoots. Successful procedures have been established for induction of adventitious shoots of several cultivars of *Buddleia* and experiments are being planned to implement mutation breeding and transformation procedures.

### **Cooperative plant testing program with Blake School**

As a means to evaluate performance of some of our pear and mountainash selections in Minnesota, we established a cooperative effort with The Blake School, a private school in Hopkins, Minnesota. The project was part of a family community service activity. Students, staff and parents planted over 40 trees on campus. In addition many families planted trees in their home landscapes. Students will evaluate trees planted on school grounds as part of the 6<sup>th</sup> grade science curriculum and families that planted trees at their homes will fill out yearly evaluation forms.

### **Improvement of Operations at our Oregon Research Station**

We continue to expand activities and improve our capabilities at our Oregon research station.



Poly greenhouse, potting shed and container area

The poly greenhouse constructed in 2004 is being utilized heavily for propagation of selected plants. Peter Podaras has been sending cuttings from many selections overnight from Cornell to Sarah Doane, our Oregon Research Station manager, who is propagating them. We have expanded our container area and soon need to expand it again. The potting shed has been a big asset in facilitating this increased effort. Even though we continue to rogue out less desirable plants, our field plantings also continue to expand as we continue to add new hybrid populations.